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SURVEY OF SANITARY FACILITIES AND POLLUTION CONTRIBUTED TO RESERVOIRS AND LAKES OF THE COLORADO-BIG THOMPSON PROJECT SOUTH PLATTE RIVER DISTRICT. BUREAU OF RECLAMATION

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
KANSAS CITY, MISSOURI

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Report on Survey of Sanitary Facilities and Pollutism Contributed to Reservoirs and Lakes of the Colorado-Big Thompson Project South Platte River District Bureau of Reclamation

Missouri Drainage Basin
Public Health Service
Kansas City, Missouri

September 1950

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16. Abstracts

Results are presented of a survey made in August, 1950, of sanitary facilities of Bureau of Reclamation installations and pollution contributed to reservoirs and lakes involved in the development of the Colorado-Big Thompson Project, in order to observe sanitary defects and to make recommendations for their correction. Three general areas are considered: Lake Estes-Marys Lake, Shadow Mountain Lake -Cranby Reservoir, and Green Mountain Lake.

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Report on Survey of Sanitary Facilities and Pollution Contributed to Reservoirs and Lakes of the Colorado-Big Thompson Project South Platte River District Bureau of Reclamation

September 1950

Prepared at the request of the South Platte River District, Bureau of Reclamation, by the Missouri Drainage Basin, Public Health Service, Kansas City, Missouri

INTRODUCTION

This survey was undertaken at the request of the District Manager, South Platte River District, Region No. 7, Bureau of Reclamation. The following is quoted from District Manager J. E. Knights' letter of July 28, 1950:

> "In order that no public criticism may be directed at the Bureau of Reclamation for current operations of our sewage disposal plants, and in order that we may get a current report on the sources of all pollution in Bureau lakes or reservoirs, this office has been requested by the Regional Office to solicit your assistance in obtaining an investigation of the situation."

Basin Engineer Glen J. Hopkins, Missouri Drainage Basin Office, Public Health Service, contacted the Colorado State Health Department, South Platte River District, Bureau of Reclamation, and Public Health Service, Region No. 9, Denver, Colorado, in order to develop an inspection trip compatible with time commitments of all concerned. It was mutually agreed to make this trip late in August 1950.

The investigation included a survey of sanitary facilities of Bureau of Reclamation installations and pollution contributed to reservoirs and lakes involved in the development of the Colorado-Big Thompson Project. The purpose was to observe sanitary defects and to make recommendations for their correction.

The following personnel made the inspection trip:

South Platte River District, Bureau of Reclamation
Civil Engineer Walter C. Chisen

Colorado State Health Department
Public Health Engineer George Schlitt

Missouri Drainage Basin, Public Health Service
Sanitary Engineer Ralph Porges

Acknowledgment is made of the excellent cooperation of all individuals contacted in the field which did much to assist in this survey. The following contributed to the investigation:

Colorado State Health Department
State Sanitary Engineer William Gahr

Region No. 9 - Public Health Service
Sanitary Engineer C. R. Bowman

South Platte River District
District Housing Engineer Robert T. Krueger

Estes Park Government Camp - Bureau of Reclamation
Construction Engineer (in charge) Frank Matejka
Sup't. of Buildings and Grounds - George B. Peck
Administrative Assistant - R. R. Wright

City of Estes Park
City Water Superintendent - Lee Tallant

Larimer County
County Sanitarian - John Hagler
County Patrolman - George Lambert

Shadow Mountain Government Camp - Bureau of Reclamation
Construction Engineer (in charge) - U. V. Ingstron
Sup't. of Buildings and Grounds - M. M. Gingery

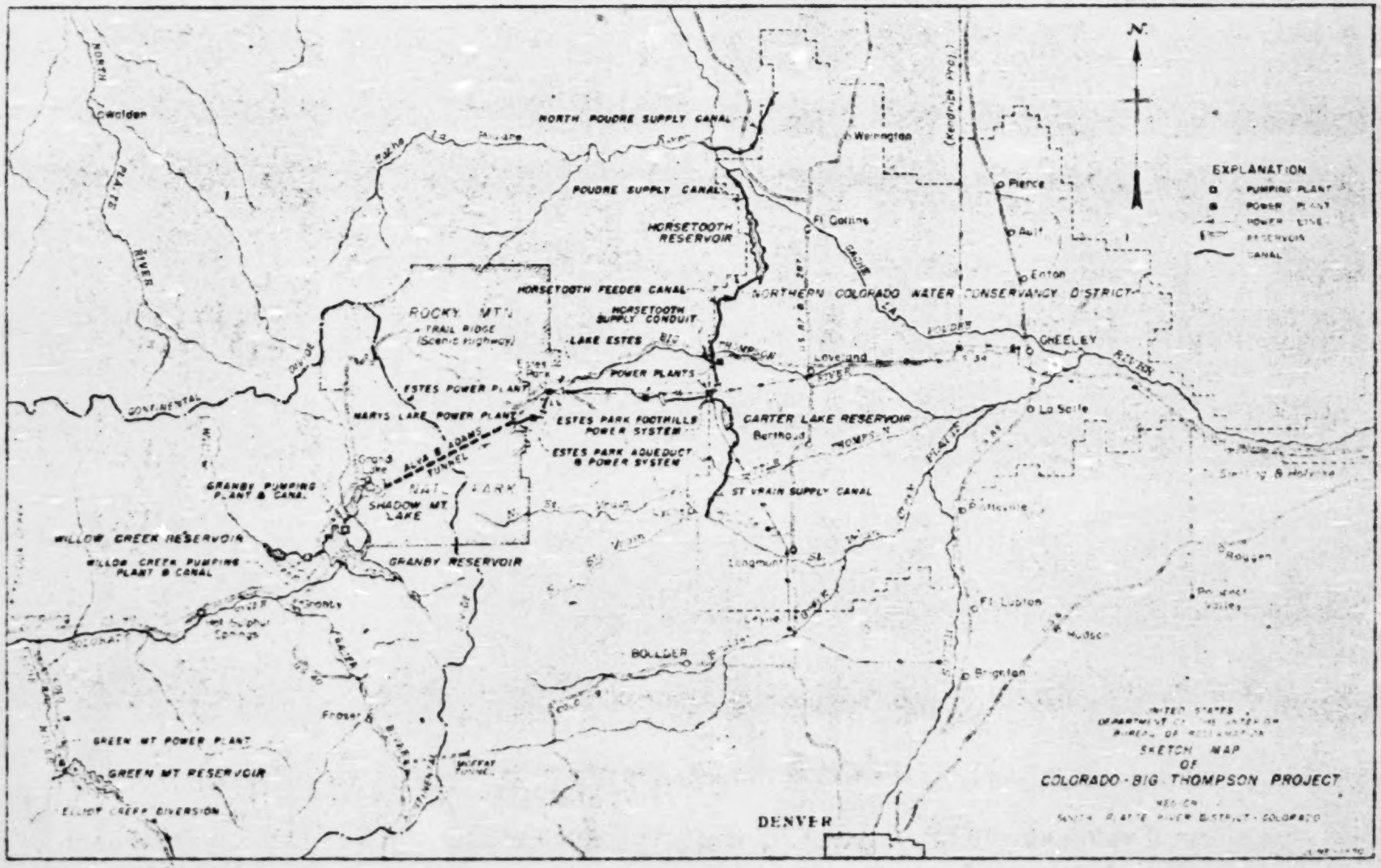
Green Mountain Government Camp - Bureau of Reclamation
Power Plant Superintendent - L. J. Neilsen

SUMMARY

An inspection of sanitary installations and pollution contributed to impoundments of the Colorado-Big Thompson Project was undertaken at the request of the South Platte River District, Bureau of Reclamation. The purpose was to note sanitary defects and to submit recommendations for their correction. The field trip was made by representatives of the Bureau of Reclamation, the Colorado State Health Department, and the Missouri Drainage Basin Office of the Public Health Service.

The impact of the development project on the area is such that existing recreational enticements will be enlarged and enhanced. Population increases will make it desirable that strict control be maintained over sewage treatment and disposal by the Colorado State Health Department to prevent pollution of surface waters. The interweaving of State, Federal and local interests in this area indicates that all concerned should confer on an over-all plan of development so that a long range program for the protection of public health may be undertaken.

Specific recommendations for the improvement of sanitary facilities at Bureau installations have been made. It is suggested that all future plans for sanitary installations be submitted to the State Health Department for formal review and written approval. Public health and sanitation features of National Park Service planning for Bureau developments also should be submitted to the State Health Department for review and approval.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TRAIL RIDGE
(Scenic Highway)
ESTES POWER PLANT
POWER PLANTS
MARYS LAKE POWER PLANT
ESTES PARK FOOTHILLS POWER SYSTEM
ESTES PARK AQUEDUCT & POWER SYSTEM
ALVA B. ADAMS TUNNEL
GRANBY PUMPING PLANT & CANAL
SHADOW MT LAKE
WILLOW CREEK RESERVOIR
WILLOW CREEK PUMPING PLANT & CANAL
GRANBY RESERVOIR
GREEN MT POWER PLANT
GREEN MT RESERVOIR
ELLIOT CREEK DIVERSION
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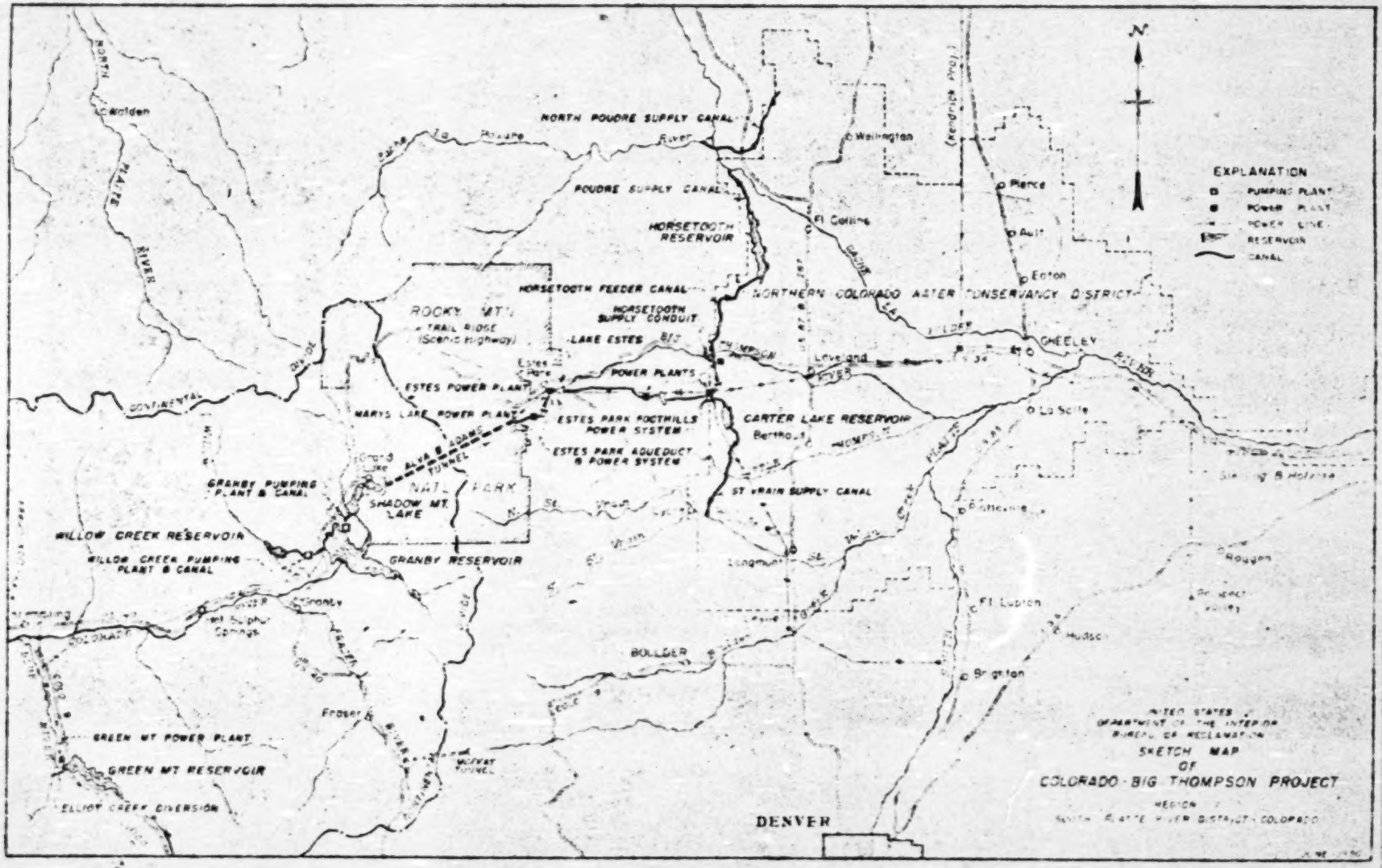
SKETCH MAP
OF
COLORADO-BIG THOMPSON PROJECT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EXPLANATION
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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
SKETCH MAP
OF
COLORADO-BIG THOMPSON PROJECT
REGION
SOUTH PLATTE RIVER BASIN, COLORADO

COLORADO-BIG THOMPSON PROJECT

Purpose

The primary purpose of the Colorado-Big Thompson Project is to provide supplemental water for irrigation in northeastern Colorado where agricultural production is limited due to a shortage of water.

The principal features of the project are listed according to the general sequence of operation.

Western Slope Replacement Storage and Improvements

The principal features are Green Mountain Reservoir and Green Mountain Power Plant. This reservoir was constructed to protect water users in the Colorado River Basin against any infringement on their water rights by diversions to the Eastern Slope.

Colorado River Collection and Storage System

This portion of the project collects and stores surplus water for diversion to the Eastern Slope through the Alva B. Adams Tunnel. The main features consist of Granby Reservoir, the principal storage for the project; Granby Pump Plant, which pumps water from Granby Reservoir to the Granby Pump Canal; and Shadow Mountain Lake. From the Granby Pump Canal water flows by gravity to Shadow Mountain Lake and thence to Grand Lake and the Alva B. Adams Tunnel to the Eastern Slope.

Estes Park Aqueduct and Power System

The main features constituting this section of the project are Marys Lake and Marys Lake Power Plant, Lake Estes and Estes Power Plant, and the interconnecting siphons and tunnels. Lake Estes serves to regulate the flow of imported waters and provide a regulated flow to the Estes Park-Foothills Power System

Estes Park-Foothills Power System

The main features include Pole Hill Power Plant, Flatiron Power Plant, Big Thompson Power Plant (proposed), and the siphons, tunnels, and canals connecting these features. This portion of the project is now under construction.

Foothills Storage and Supply System

This system, part of which is under construction, will receive water from Flatiron Reservoir, transport the water to conveniently located reservoirs for storage, and deliver supplemental water to existing irrigation facilities. South from Flatiron Reservoir the system includes Flatiron Pump Plant, Carter Lake Pressure Tunnel, Carter Lake Reservoir, and St. Vrain Supply Canal. North from the same point it includes Horsetooth Feeder Canal, Horsetooth Reservoir, Dixon Feeder Canal, and the Poudre and North Poudre Supply Canals.

Power Transmission System

In addition to the power plants constructed, the power development phase of the project plan includes delivery of salable energy to preference customers in the market area. A network of transmission lines and substations is being constructed to connect the various power plants with load centers serving municipalities, communities, and REA cooperative systems in Colorado, Wyoming, and Nebraska.

Recreation

The project-created reservoirs in a region famous for its mountains and forests assures maximum public use of the area through the development of recreational facilities in cooperation with the National Park Service and the Fish and Wildlife Service.

GENERAL DISCUSSION

The region through which the Colorado-Big Thompson Project traverses is one of scenic beauty and rocky vastness typical of the Colorado Rocky Mountains. Estes Park, a mountain resort at the head of Lake Estes, is located approximately 75 miles northwest of Denver, Colorado, and readily accessible by U. S. Highway No. 34 and State routes 66 and 7. About three miles west of Estes Park is the eastern boundary of the Rocky Mountain National Park which extends over the Continental Divide to the vicinity of Grand Lake. It is through these high ridges that the Alva B. Adams Tunnel conveys water from Grand Lake to Marys Lake. Grand Lake and Shadow Mountain Lake are approximately 20 miles southwest of Estes Park on the western boundary of the National Park. Highway 34 from Estes Park travels approximately 60 miles to Grand Lake. Granby Reservoir is approximately 4 miles southwest of Grand Lake and Green Mountain Reservoir 58 road miles to the southwest.

Development of this region paralleled that of the adjoining sections of Colorado. Individuals in the pursuit of recreation realized the advantages of this area and enjoyed the mountain scenery and excellent fishing provided by streams. Gradually, communities such as Estes Park and Grand Lake developed and numerous camps and summer locations were established primarily in Big Thompson Canyon and in the vicinity of Estes Park and Grand Lake. Pressure from those seeking recreation has increased in recent years and may be expected to expand as those from more crowded areas come to enjoy the scenic wonders and solitude of the mountainous areas of Colorado.

The developments of the Bureau of Reclamation will do much to enhance the recreational possibilities of the area. Green Mountain

Reservoir, Granby Reservoir, Shadow Mountain Lake, Marys Lake, and Lake Estes have been formed by impounding structures of the Bureau of Reclamation. Some of these impoundments are not suitable for heavy recreational development because of the wide fluctuations of water levels that will occur. MarysLake, Granby Reservoir and Green Mountain Reservoir will be subject to wide fluctuations, however, Lake Estes formed by Olympus Dam on Big Thompson River and Shadow Mountain Lake will have relatively stable water levels. Shadow Mountain Lake which feeds to Grand Lake will have a fluctuation of about one foot. Accordingly it may be expected that the lakes with a rather uniform water level will receive considerable usage from recreational enthusiasts. Other reservoirs, although subject to considerable change in their water levels, will provide suitable sites for cabins and may also develop fishing possibilities. The National Park Service cooperating with the Bureau of Reclamation have investigated the various locations and are planning developments of recreational sites.

In addition to the developments of the area by State and Federal agencies, recognition must be made of the concurrent and associated development by the public in general. The impoundment of large bodies of water enhances recreational pursuits and considerable impetus has been given to private interests.

The presence of large numbers of people in this area will bring about sanitation problems. Potable water supplies is a vital necessity and proper sewage disposal is urgently needed to protect the natural resources. Because of the interwoven problem of government and private interests, it is desirable that an over-all plan of development be mutually agreed upon by those responsible for the planning of the area. An understanding should be

reached between State and Federal agencies regarding development plans so that a long range program may be undertaken to adequately protect the health of residents and visitors to the area. It is considered essential that the State Health Department be consulted regarding sanitation matters.

SURVEY

To facilitate presentation of data, three general areas have been considered: (1) Lake Estes-Marys Lake; (2) Shadow Mountain Lake-Granby Reservoir; and (3) Green Mountain Reservoir.

LAKE ESTES-MARYS LAKE

Lake Estes, formed by Olympus Dam across Big Thompson River, was constructed primarily to regulate irrigation water conveyed from the western slopes of the Rocky Mountains. Normal flow of Big Thompson River will be by-passed to maintain stream conditions in Big Thompson Canyon.

Marys Lake, located approximately three miles southwest of the community of Estes Park, receives water discharged by Marys Lake Power Plant and in turn feeds Estes Power Plant.

The region is highly developed from the standpoint of seasonal tourists' trade. The community of Estes Park, located along the Big Thompson River a short distance above the upper reaches of the lake, has an all-year-round population approximating 3,000 and a summer peak within a 25-mile radius in the neighborhood of 50,000. The lake receives considerable recreational use. Boating facilities are provided. Fishing is undertaken and possibly some swimming, although the temperature of the water is quite cool. The climate of the area, its scenic wonders and its proximity to the population in the Denver area indicates an increase in the recreational pressure on the resort. This viewpoint has been taken by the

National Park Service who has prepared plans regarding the recreational developments including boating, fishing, and picnicking.

Water from Lake Estes supplies numerous uses. The normal flow of the stream will be by-passed to Big Thompson Canyon, an area extending eastward about 23 miles, extensively used as a recreational area. Big Thompson River is used downstream as the public water supply for Loveland, Berthoud, and Johnstown, and serves a population of over 10,000. The waters of the lake and that of the river abound in fish and are used extensively by anglers. West slope diversions, after passing through the power plants at Marys Lake and Lake Estes, will be diverted to irrigation canals for use in the lower valleys.

The complexity of the development of this area indicates the vital need for cooperative planning among state, local, and federal interests. It is deemed essential that firm plans regarding the future development of this area be made so that public health and sanitation needs receive adequate consideration.

Estes Park Government Camp and Power Plant

On the right bank of Lake Estes is the Estes Park government camp, headquarters for the Colorado-Big Thompson Project. The government area includes the administration buildings, service garage, warehouse, power plant, and approximately 75 dwelling units. The population in this village will exceed 300 people and may approximate close to 500. The structures are of a permanent type and a certain basic staff will be maintained in this area although a portion of the present development may eventually become a part of the city of Estes Park.

Water is secured from Estes Park. The supply is tested periodically by the State Health Department and it is reported to meet acceptable

bacteriological standards (Public Health Service Drinking Water Standards - 1946). Present consumption is approximately 50,000 gallons per day.

All building units with the exception of the warehouse are connected to a sewer system discharging to a sewage treatment plant providing settling, sludge digestion, filtration by a trickling filter, filter effluent chlorination, and sludge drying. The primary unit consists of a Coberly tank, a modified Imhoff tank, which is a trapezoidal-shaped unit with the sewage flowing into the narrow end and discharging over a weir at the opposite or wide end. Settling occurs in the center of the tank with a sludge chamber on the bottom and gas vents along the sides. A series of transverse triangular baffles act as gas retainers which apparently convey gas to the side area and also act to separate the sludge area from the settling tank. At the time of this survey the gas vents were covered with a heavy, thick scum and gas bubbles could be seen rising in the settling compartment of the tank.

The settling tank effluent passes through a dosing tank which intermittently doses the trickling filter. The trickling filter is of standard type, 25' in diameter with 7' of rock. The settled sewage is distributed over the bed by five fixed nozzles. Some nozzles were slightly clogged with organic matter. Inspection of the trickling filter indicated that it was operating satisfactorily. It was reported that the rock in the unit was replaced about three months ago because of clogging.

The effluent from the rock filter is chlorinated with 1 p.p.m. chlorine, which is too low to be effective. Secondary settling is not provided. The final effluent is discharged to an open ditch and subsequently reaches Lake Estes. Sludge from the Coberly tank may be drawn to sludge beds.

The warehouse is provided with an independent sewage disposal unit, consisting of a septic tank 8' x 4' x 3', and a subsurface drainage field. It was reported that sludge was removed from this unit approximately three weeks prior to this inspection. As the tank is covered with earth and inaccessible for inspection, it was not possible to view the contents of the tank. Apparently the unit is operating entirely satisfactorily. However, it is felt that consideration should be made in the future of connecting the warehouse to the sewer system and discontinue using the septic tank.

Marys Lake

Marys Lake region possesses noteworthy scenic attractions, although the lake itself may not be conducive to recreational development because of wide daily fluctuations in water levels. The area surrounding the reservoir is moderately settled as a resort with cabins, hotels and homes.

Bureau of Reclamation facilities at Marys Lake consist of a power plant which will have an operating crew working out of the camp at Lake Estes. Potable water will have to be brought in by the individuals working at the plant.

Sewage disposal is provided by a septic tank--6' x 3' x 5'. The effluent from the septic tank discharges to the four-inch field drain tile ending in a blind header. At the end of the leaching field, a six-inch perforated underdrain picks up any draining liquids and discharges them to Marys Lake. Although the unit appears satisfactory, the septic tank was covered with a layer of earth and accordingly was not accessible for inspection.

Estes Park

The town of Estes Park is a popular recreational area. The summer population connected to the water and sewage systems was estimated in 1949

to be as high as 6,000 with a year-round connected population of 1,200. At the time of the inspection it was reported that the off-season population may approach 3,000, all of whom are not served by municipal services.

The source of water supply for Estes Park is Glacier Creek and Black Canyon. The supply, with a capacity of 1,000,000 gallons per day, receives chlorination. Routine bacteriological tests, as reported by the State Health Department, indicate a satisfactory water.

The sewage treatment plant serving Estes Park consists of comminutor, primary settling, standard trickling filter, chlorination of trickling filter effluent and separate sludge digestion. The final effluent is discharged to Big Thompson River a short distance above Estes Park Lake. It was reported by the city water superintendent that the sewage plant is operated by a sanitary district which includes Estes Park and a portion of the surrounding country. The plant, operated since 1940, reportedly was designed for 450,000 gallons per day. Summer peaks may exceed the capacity rate of the plant and short time rates as high as 1,000,000 gallons per day have been recorded. Secondary settling is not provided. The chlorination capacity is 11 pounds per day which appears low for treatment of the indicated volumes of trickling filter effluent.

Discussion

Considerations of sewage treatment in the Lake Estes region will depend upon water use. Prime uses of water from Estes Park Lake are irrigation and public water supply. Other uses include recreation and conveyance of sewage and its ultimate disposal. With the indicated prime uses of water, the prevention of bacterial contamination will be one of the principal tasks of sewage treatment. This will also improve recreational uses as fishing, boating, and bathing. Accordingly, it appears that complete removal

of sewage or a high degree of treatment plus chlorination of the final effluent is indicated as has been the requirement of the State Health Department. Cooperation between state, local, and federal agencies should be planned to reach the established goals regarding the degree of treatment wastes should receive.

During 1949, a stream pollution investigation of the South Platte River Basin was made by the Public Health Service in cooperation with the Colorado State Health Department at the request of the Bureau of Reclamation. The report included consideration of the public water supplies taken from the Big Thompson River by Loveland, Berthoud, and Johnstown, and shows the sources of pollution. It noted that a large number of cabins and resorts are located in the canyon's watershed and recognized that sewage disposal from these sources is rigidly controlled. Laboratory results of samples taken from the Big Thompson River in the vicinity of Loveland water works intake showed that the bacteriological quality of the water was relatively good in spite of the heavy use of the canyon for resort purposes. The levels of dissolved oxygen in the Thompson River were in excess of 90 percent saturation during the summer season. The biochemical oxygen demand of the stream was relatively low. The effects of pollution are shown most strikingly by coliform results. During the summer season the median coliform in the stream above Estes Park was less than 100 per 100 ml. A sharp increase results from pollution in Lake Estes as indicated by a concurrent median rise to 2,300 per 100 ml., and this same order of magnitude extends down the canyon to Loveland. In general the results of this study would indicate that conditions are not bad and reflect the interest and activities of the State Health Department towards the prevention of gross contamination of surface waters.

Sewage treatment at the Government Camp and Estes Park could be improved. As tabulated by the South Platte River Pollution Survey previously referred to, these sewage treatment facilities are credited with a secondary type of treatment but no effective pollution removal. The absence of secondary settling units to retain organic solids sloughed off by the trickling filters at infrequent intervals accounts for this. In fact, during the time accumulated biological filter growths are discharged, the effluent may constitute a greater pollutant than the raw sewage. The large amount of organic matter discharged makes chlorination during these times ineffective. Also, chlorine must be kept in contact with the sewage over a period of time to be most effective. Accordingly, it is suggested that consideration be given to a final settling tank, chlorination contact chamber, and final discharge through an extended sewer line to deep water to take advantage of the large amount of dilution being passed through the power plant and Lake Estes. The capacity of the chlorine feed should be enlarged.

Plans for the municipal sewage treatment plant at Estes Park were not available for review. However, it is believed that existing units are probably of adequate design to generally handle sewage flow. It is suggested that flow and plant characteristics be studied as recorded flows indicate peaks of 1 M.G.D. although daily averages are probably no greater than 0.6 M.G.D. A secondary settling tank with a retention period of 1-1/2 hours should be installed. Following the secondary settling unit a contact chamber for effective chlorination with a twenty-minute detention period should be provided. The final effluent should be discharged through an extended outfall line to deep water of the lake so as to take advantage of the large amount of dilution water that will be afforded by the development project.

Several factors must be considered in the Government Camp sewage disposal problem. Assuming the desire and need to prevent bacterial contamination because of downstream water use and the desire to enhance recreation, a high degree of sewage treatment and effective chlorination of the effluent is necessary. Following through on this thought, secondary settling of the effluent after passage through the trickling filter will be needed. The secondary tank should provide a detention period of approximately 1-1/2 hours and some means of sludge disposal must be provided for. Consideration should be given to the installation of an Imhoff tank. Following the secondary settling tank, a contact chamber for effective chlorination providing a twenty-minute detention time should be considered. The effluent should be discharged to deep water through an extended sewer line to remove evidences of sewage from the shoreline and to take advantage of the large amount of dilution water afforded by the development project. Provisions must be made for ultimate disposal of the settled and digested sludge. This can be done either by draining to sludge beds or by manually removing it.

The primary settling tank should be operated more effectively by breaking the scum in the gas vents and by more frequent sludge removals. The plant is probably under-designed for the current sewage load but may suffice when normal permanent operating personnel are established. The nozzles distributing sewage over the filter should be kept clean so as to achieve maximum efficiency.

Another consideration in the matter of sewage disposal at the present location is the proposed recreational plan. It was indicated that the present sewage plant is in the principal recreational development area as visualized for this lake area by the National Park Service. Also the shoreline of the reservoir behind Olympus Dam extends up to the present plant

outfall. Relocation of the sewage disposal unit may be necessary. It seems that the most satisfactory solution would be to remove the plant completely and pump the sewage by the existing pumping station to the municipal disposal plant at the community of Estes Park. It is believed worth-while to fully explore this possibility, which would permit the handling of all sewage at one plant and eliminate Bureau operation of a disposal unit. Such a solution would involve a mutual understanding with the community of Estes Park and will probably require a meeting between the State Health Department, city officials and Bureau personnel to arrive at a satisfactory solution.

The tremendous use of the general area around Estes Park Lake by innumerable tourists indicates the need of proper sanitary facilities. Public drinking water facilities and toilet installations should be provided in the general area of the power plant. The area on the opposite bank of the lake is used quite extensively for fishing and other recreational pursuits including boating, and suitable toilet facilities should be provided. Pit privies could be considered as an emergency measure until the installation of more modern facilities is feasible.

Recommendations

1. A firm over-all plan for the development of the Lake Estes region be reached by the Bureau of Reclamation, National Park Service, State Health Department and local interests. This should include recreational developments and the disposal of sewage from government facilities, Estes Park, and recreational areas.

2. The Bureau of Reclamation explore the possibility of having their sewage treated at the municipal plant at Estes Park. It will be necessary to confer with state and local officials to adjust differences and to achieve the required cooperation.

3. If it is necessary to maintain a sewage treatment plant at the government camp, the plant be expanded by installing final settling tank and a chlorine contact chamber following which the effluent should be conveyed to deep water by extending the outfall sewer. Facilities must be considered for ultimate sludge disposal.

4. Maintenance of Bureau sewage plant be improved to include frequent breaking of scum and floating material in gas vents of the Coberly tank and removal of material clogging nozzles of the sprinkling filter.

5. The City of Estes Park expand its sewage treatment plant to include final settling, a chlorine contact chamber, increased chlorine capacity, and an extension of the sewer outfall to deep water in Lake Estes.

6. The sewer line from the warehouse at the Estes Park Government Camp be connected to the general sewage system if and when practicable.

7. Swimming not be permitted nor a bathing beach be constructed until secondary settling tanks and chlorine contact chambers have been constructed and placed in operation and bacteriological tests prove the water safe for swimming.

8. Additional privies be installed at specific locations around Lake Estes recommended by the county sanitarian as an emergency measure to further improve sanitary conditions until the installation of more modern facilities is feasible. Privies should be constructed in accordance with State Health Department recommendations and provisions made to insure maintenance.

9. Septic tank manholes at Marys Lake and the warehouse be raised to ground level so inspection may be readily made and sludge removal facilitated. Septic tank inspections be conducted on a routine basis at least once a year and when the combined sludge and scum blanket exceeds 20 inches in depth the accumulated material be removed from the tank.

10. All Bureau of Reclamation plans for sanitary installations be submitted to the State Health Department for review and approval prior to constructi

SHADOW MOUNTAIN LAKE-GRANBY RESERVOIR

In this region the development program of the Bureau of Reclamation involves pumping Colorado River water impounded in Granby Reservoir to Shadow Mountain Lake, an artificial impoundment which drains to Grand Lake and thence to the Alva B. Adams tunnel. The water elevation of Shadow Mountain Lake and Grand Lake will not vary more than one foot, which favors recreational usage. These uses will include boating, fishing, enjoyment of its natural beauty, and possibly some swimming although the air temperature is relatively low and the water is quite cold.

The community of Grand Lake is a resort area of long standing. It is situated on the shores of Grand Lake which has on its marginal fringe numerous summer homes and cabins. Sports related to the lake include boating, fishing and bathing.

It is reported that the community has no municipal water or sewage system.

Shadow Mountain Government Camp

The Bureau of Reclamation camp at Shadow Mountain Lake is a permanent location. The Government area includes an office building, garage, workshop and 106 homes. Some distance away from the main unit are 9 abandoned cottages from an old CCC camp.

The water supply is obtained from a graded gravel filter trench in the bed of the Colorado River. The filter has been ingeniously constructed by Bureau personnel so that it may be backwashed with either water or air. Visual inspection of the filter indicated that it is operating satisfactorily. As the water passes through the pump house it is chlorinated and then conveyed to a 10,000 gallon storage tank. A residual of 0.3 parts per million

chlorine is maintained throughout the system.

The pump well consists of an open concrete riser with open joints. It should be sealed to prevent extraneous matter as rust, dirt and other material from reaching the potable supply. The overflow pipe should be screened with rust-resistant material having a mesh not greater than 3 x 3 and all other pipes to the well should be permanently sealed. It may be desirable to concrete the earth floor surrounding the riser pipe.

There are four septic tanks serving the Government area, of which three are active. These latter three are very similar, with the following net dimensions: 27' 6" x 10' x 4' 6". The effluents from these three septic tanks discharge to three individual rock contact filters 60' x 25' x 5'. The filters are underdrained and the final effluents are discharged to Shadow Mountain Lake. The First Street system serves 54 houses, the workshop, garage, and office building; the Second Street system serves 22 houses; while the Third Street system has 30 houses connected. The fourth septic tank served 9 abandoned cottages and washhouse in the old CCC camp area.

The contents of the three active tanks were inspected and considerable amounts of sludge noted. It was observed in some cases that the inlet T was defective and the possibility exists that the outlet T may also be damaged. Inspection of the filter system seemed to indicate it was operating satisfactorily and the rock bed showed no indication of an excessive accumulation of solids. The rock filters were not filled to ground level and constituted an accident hazard besides exposing the septic tank effluent to animals and possibly human contact. The discharge lines feed to quiescent reaches on the shore of Shadow Mountain Lake which have poor circulation and create unsightly septic conditions.

Discussion

The Grand Lake-Shadow Mountain Lake area is a popular summer resort region. The recreational use of lake waters would indicate the need for the prevention of contamination by sewage. Present Bureau of Reclamation sewage disposal facilities at Shadow Mountain meet this requirement. Future development plans should be discussed with the Colorado State Health Department.

In general the sewage disposal systems appear to be working satisfactorily, yet design features and other factors tend to inconvenient operation and ease of maintenance. Basically the septic tanks appear to be of satisfactory design, although the First Street system tank handling 54 houses besides the office and service area may have insufficient capacity. Also the ratio of depth of liquid to length of tank appears to be lower than that to secure maximum results. For ease of maintenance, inspection, and clean-out operations, tanks of 27 feet should have a minimum of three manholes of such size that a man can easily enter the tank. The sludge removal problem indicates the desirability of future consideration of installing large septic tanks at such elevations that sludge drains may be built into the tank for removal to sludge drying beds.

Inspection of the three active septic tanks indicated excessive accumulations of sludge and scum. All septic tanks should be inspected periodically, at least once each year and more often when the capacity may be exceeded, and sludge removed when the combined scum and sludge depth exceeds 20 inches. As the Bureau of Reclamation has numerous septic tank installations in the South Platte Division that require periodic servicing, it is suggested that a vehicle or trailer unit be outfitted with suitable tank and pumping equipment so that routine cleaning may be most effectively and efficiently carried out. At the time of this visit operating personnal

at Shadow Lake were contemplating the use of commercial cleaners to remove the sludge from the septic tanks. There are no known chemicals which will remove satisfactorily the sludge from septic tanks or drainage fields. The "septic tank cleaner" is probably caustic soda which may possibly loosen the sludge which in turn will flow over into the field and tend to cause clogging. The "septic tank conditioner" is a sodium bisulfate neutralizer. There are no known substitutes for the mechanical removal of sludge from septic tanks.

Recommendations

1. Shadow Mountain water supply pump well be covered to prevent contamination reaching the supply. The concrete riser joints be sealed. The overflow pipe be screened and all other pipes permanently sealed.

2. Sludge be removed from the three active septic tanks at Shadow Mountain. A schedule of inspection for all tanks should be set at least at yearly intervals and when the combined depth of scum and sludge exceeds 20 inches the tank should be cleaned.

3. Septic tank influent and effluent appurtenances within the tank proper should be inspected and repaired if damaged.

4. Additional clean coarse gravel should be placed over the existing filter fields to bring the top of the field to grade. It would be desirable that flushing pipes be installed from the distribution header to grade for cleaning purposes.

5. The effluent outfall lines be extended approximately 50 feet to deep water to prevent shoreline nuisance and to take advantage of the dilution afforded by the lake water.

6. The septic tank effluent from Granby Power Plant be diverted from Granby Reservoir by discharge to a drainage field or other secondary

disposal method.

7. Future sanitary installation plans be transmitted to the State Health Department for review and approval.

Green Mountain Reservoir is located about 15 miles upstream from the confluence of the Blue River with the Colorado River. It was constructed for the purpose of providing water as a replacement for that diverted by the Colorado-Big Thompson Project. In addition, a portion of the capacity is to be utilized for the development of hydroelectric power. The unit was completed and put into service in May 1943.

The reservoir lies in a valley between the Williams Range and the Gore Range. The population in the general region is very sparse consisting primarily of ranches and entrepreneurs commercializing on sportsmen and reservoir uses. Since the impoundment, numerous cabins and cottages have been built on the reservoir margin for public and private use. The principal recreational pursuits in the area are fishing, boating, camping, and some picnicking. The reservoir, because of wide fluctuations, will tend to retard uses as bathing and boating with any of the larger pleasure craft. In addition, the temperature of the water and the lack of suitable beaches eliminates bathing from any large consideration. As better roads provide access to this region it may be anticipated that additional pressure will be placed upon the region. The National Park Service, in cooperation with the Bureau of Reclamation, has developed recreational plans for the area. These include parking areas, picnicking sites, boat launching facilities and the accompanying sanitary facilities as water supplies and sewage disposal.

Government Camp

The Government camp is located below Green Mountain Dam in a canyon of the Blue River. Included in the camp is the power plant, garage, and

about 25 houses; a total population of 85 people.

The present water supply is obtained from a spring in the side of the canyon above the dam. The spring is encased, although not watertight, and feeds to a 10,500 gallon storage tank. The storage tank has an overflow pipe and a vent, neither of which is screened. The water then proceeds by gravity to the distribution system. Although no treatment is provided the water quality as indicated by bacteriological analysis conducted by the State Health Department is reported to be satisfactory. For fire protection and irrigation a supplemental source of water is provided by Elliott Creek.

Construction is presently under way on a new water system. The water supply will be taken from the penstocks and passed through a pressure filter, chlorinated by a hypochlorinator and pumped to storage by a one and one-half inch pump of 50-gallon-per-minute capacity. The storage tank will be the same one as used in the present system. The water lines are to be four-inch lines.

Fire protection is to be provided by pumping raw water from the penstock directly to the potable system. This may introduce contaminated water into the potable system which will require sterilization and flushing of the entire system before it will again be safe for domestic use. The fire system therefore becomes of public health significance. In addition, the contemplated system may not have sufficient capacity to provide water for all domestic uses.

The power plant is serviced by a septic tank which is below ground level and not accessible for inspection. The effluent from this unit discharges to the tailrace. Considering downstream water use, volume of flow, and the small amount of waste discharged, this method appears satisfactory.

The remainder of the camp is served by a separate sewage system and

a septic tank located at the bottom of a cliff 50 feet below the village proper. The septic tank is 9 x 7 x 6 feet with a flow depth of about 5 feet. Inspection of the septic tank revealed large volumes of sludge although reportedly the unit was cleaned three months ago. Cleaning was done by hand bucketing because of inaccessibility of the tank. The effluent is discharged to a drainage field, a portion of which is drained and discharges to the river.

Garbage is hauled at weekly intervals to a site approximately three-fourths of a mile away. The dump is maintained as a modified sanitary fill. A trench is made by a caterpillar tractor and the waste material is dumped into the pit. Trash is burned and the dump covered periodically at approximately monthly intervals. Suitable garbage disposal sites have been difficult to locate in this area because of the rocky terrain. A large number of chipmunks was noted around the dumping area.

Discussion

A suitable water supply for a permanent installation should consider all domestic uses, including sprinkling of gardens and lawns, and fire protection. A system satisfying all of these needs eliminates any danger of cross connection between systems and removes a potential public health hazard. The system under construction at the present time would satisfy all uses if adequate storage is provided as the pumping facilities will be unable to keep up with the demand under extreme emergency conditions. Increasing existing storage facilities to 25,000 gallons by another 15,000-gallon storage tank would satisfy this need. The additional storage tank should be constructed at an available site next to the present tank.

If present plans to provide fire protection by pumping raw water through the potable system is followed, adequate chlorination equipment

should be installed on this raw water intake to assure disinfection of the water so used.

Before placing the new water system into operation it should be disinfected. The complete system, including the pressure filter and storage t nks, should be treated with a solution of 50 parts per million chlorine which solution should be maintained in the system for a minimum of 4 hours, at which time the chlorine residual should not be less than 0.5 of a part per million. The system should be then flushed completely, refilled with the potable water supply and the bacteriological check for satisfactory quality made immediately. A concentration of 50 parts per million chlorine will require 0.6 of a pound high test calcium hypochlorite or 2 pounds chlorinated lime per 1,000 gallons of water.

Various factors enter into the sewage disposal problem. It is necessary that the waste be conveyed to the proper disposal unit, the final effluent discharged and ultimate disposal provided for the sludge. Another consideration is the ease by which the unit may be maintained. With a population of 85 the net tank capacity should be about 10,000 gallons; the existing tank has approximately 5,000 gallon capacity. At this site it is suggested that a hopper bottom tank be considered which should be located at the top of the cliff to facilitate sludge removal. With proper sludge outlet at the bottom of the tank, the unit could be cleaned by draining to prepared sludge-drying beds at the bottom of the cliff. Breaking the scum and loosening the sludge with a fire hose would then be a simple procedure. The existing sewer line down the cliff, if properly valved, could be utilized for both effluent and sludge. A tank of 10,000 gallon capacity should have a minimum of three manholes raised to ground level for ease of access. The existing tank may then be used

as a secondary unit and the effluent discharged to the existing drainage field. The outfall line should be extended to deep water. If soil conditions are such that the drainage field is unsatisfactory an effluent header to an inaccessible portion of the canyon which would discharge through several nozzles and permit the septic tank effluent to oxidize as it ran down the canyon wall might prove satisfactory. All septic tanks should be inspected at least yearly and cleaned when the combined depth of sludge and scum exceeds 20 inches.

The garbage disposal method appears quite satisfactory. The modified sanitary fill procedure in this area was very well maintained. However, it is suggested that an effort be made to cover the dump at weekly intervals, particularly during the warm months of the year. This procedure would tend to control to a certain degree the rodents observed in the vicinity of the dumping area. The representative of the State Health Department indicated that the State had personnel available for consultation and demonstrative purposes in rodent control. A request for this service should be made to the State Health Department.

Recommendations

1. The spring be encased with a watertight casing.

2. Storage tank overflow and vent be screened with rust resisting material with a mesh no greater than 3 x 3.

3. Plans of the new water system be submitted to the State Health Department for review and approval. It is suggested that chlorination facilities of sufficient capacity be installed on the raw water intake for fire protection to assure proper disinfection or adequate storage be provided in the domestic system for all domestic uses and fire protection. An addition of 15,000 gallon storage capacity should suffice.

4. Before the new water system be placed in service that it be flushed, disinfected with a minimum of 50 parts per million chlorine for a period of four hours, checked for 0.5 of a part per million residual, flushed, filled with potable water and a sample submitted for bacteriological test. A satisfactory test should be obtained before using.

5. Manhole of the septic tank handling sewage from the power plant be raised to ground level to facilitate inspection and clean out.

6. Septic tanks be inspected at least yearly and sludge removed when combined depth of scum and sludge reaches 20 inches.

7. A septic tank of 10,000-gallon capacity be added to the existing system handling wastes from the camp. It should be constructed on top of the cliff so as to be readily accessible for servicing and cleaning. It should have a hopper bottom with sludge drain to drying beds.

8. The modified sanitary fill be covered with earth on a weekly basis.

9. Rodent control measures be instituted where needed. Assistance should be requested from the State Health Department who indicated such consultative and demonstrative services were available.

10. Plans for sanitary facilities be submitted to the State Health Department for review and approval.

11. Plans of public health facilities as developed by the National Park Service for Bureau developments be reviewed and approved by the State Health Department.

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